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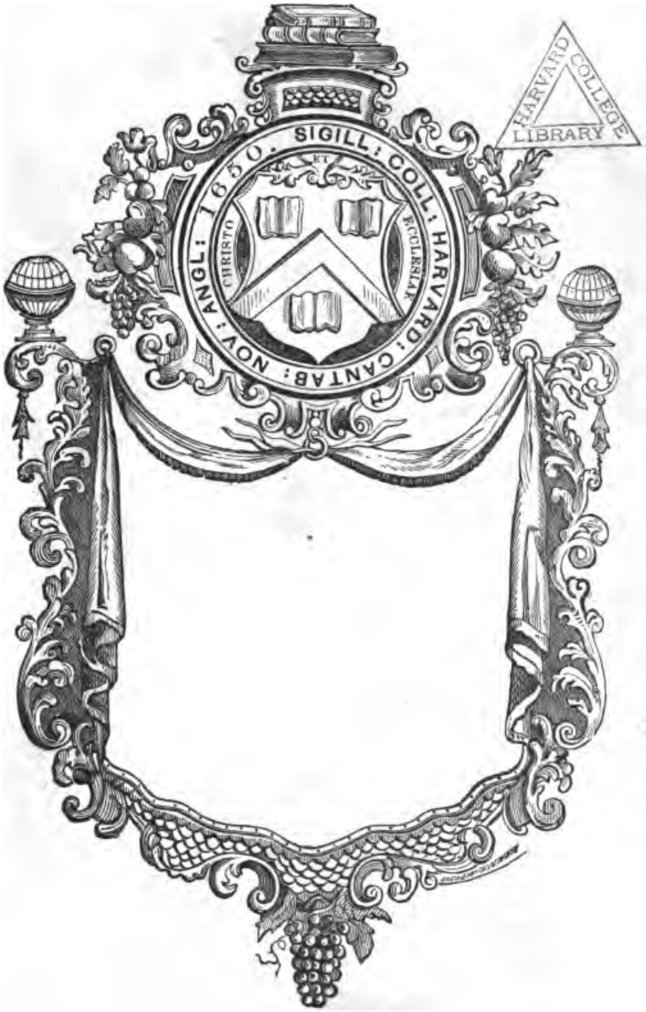
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[FROM THE FOURTH ANNUAL REPORT OF THE STATE BOARD OF HEALTH, LUNACY, AND CHARITY.]

Cover

OUR EYES

AND

OUR INDUSTRIES.

BY

Benjamin

B. JOY JEFFRIES, A.M., M.D. (HARVARD),

FELLOW MASSACHUSETTS MEDICAL SOCIETY; OPHTHALMIC SURGEON MASSACHUSETTS
CHARITABLE EYE AND EAR INFIRMARY, CARNEY HOSPITAL, AND NEW-ENGLAND
HOSPITAL FOR WOMEN AND CHILDREN; MEMBER INTERNATIONAL
PERIODIC CONGRESS OF OPHTHALMOLOGY, AMERICAN
OPHTHALMOLOGICAL SOCIETY, ETC.

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1883.

COLOR-BLINDNESS:

ITS DANGERS AND ITS DETECTION (*Revised and Enlarged Edition*). By B. JOY JEFFRIES, A. M., M. D. (Harvard), Fellow of the Massachusetts Medical Society; Ophthalmic Surgeon Massachusetts Eye and Ear Infirmary, Carney Hospital, and N. E Hospital for Women and Children etc. 1 vol. 8vo. $2.00. Published by Houghton, Mifflin & Co., Boston.

THIS important work has been heartily welcomed by medical and scientific journals in America and Europe. It has been adopted as a standard manual for medical officers of the United States Army, Navy, and Marine Hospital service. A careful perusal of the following notices will show in what esteem it is held by competent judges in both hemispheres:—

"In this present treatise Dr. Jeffries gives us 'a good part of Prof. Holmgren's book,' and he contributes, on his own part, the result of over eighteen thousand testings for color-blindness, made by himself according to Prof. Holmgren's method, with colored worsteds, among New England teachers and scholars. Both works are, first and foremost, 'practical,' having in view the elimination of color-blind persons from the railway and marine services." — *The Nation, New York.*

"We have to thank Dr. Joy Jeffries for his very intelligently written and useful little volume, which fills a hiatus that has been much felt. In this he has not only collected the principal facts that have been given by his predecessors, but he has added the results of his own observations and labors. We have great pleasure in recommending Dr. Jeffries's book to all who are engaged in the examination of the color-blind." — *The Lancet, London.*

"To Dr. B. Joy Jeffries is due the credit of bringing this matter to the attention of the United States in a way which cannot fail to produce good results. In a busy professional life he has still found time for a thorough study of all that has been printed on the subject, for correspondence with the scientific men abroad who have investigated it, for translations from many languages, and for making here thirty-four thousand examinations for color-blindness." — *Boston Daily Advertiser.*

"Dr. Joy Jeffries of Boston, who has himself contributed to the general stock of knowledge of this subject, has done English-speaking people everywhere a service in presenting the results of those labors, and especially of Prof. Holmgren of Upsala, in the present exhaustive manual." — *The Scotsman, Edinburgh.*

"This book is written throughout from a practical point of view. The author is chiefly occupied with a consideration of the practical effects of color-blindness and the dangers caused by it." — *Journal of the Society of Arts.*

"The author's aim is essentially practical. He seeks to point out the dangers to life and property which may arise from the employment on railways or on shipboard of men defective in the color-sense, and to explain in detail the best means for their detection. These dangers are undoubtedly real and serious. To the medical profession it will prove an indispensable guide in the examination of supposed cases of color-blindness." — *Journal of Science.*

"There is no doubt of the existence of this dangerous defect of vision amongst railway employés, and no time should be lost in taking steps to institute a thorough examination of railway employés throughout the kingdom. The volume now under review deals very fully with the whole question, and very clearly explains the method to be adopted in examining for color-blindness." — *The Railway News and Joint Stock Journal, London.*

"This is an interesting contribution to this important subject. The author has been successful by his unremitting zeal and perseverance in arousing public attention in America to the danger of employing color-blind railway officials." — *The British Medical Journal*

"It is opportune that we are able to announce the appearance of a work which, although not by an Englishman, is in our language, and will therefore make the English-reading public acquainted with what has been done. The author is ophthalmic surgeon to several hospitals. He is otherwise much connected with ophthalmological matters, and has had large experience in regard to color-blindness." —*Nature, London.*

"A volume has been published by B. Joy Jeffries, M. D., of Boston, entitled 'Color-Blindness: Its Dangers and Detection,' which is an exhaustive popular statement of all that is at present known on the subject, and is fully up to the standard we have indicated." —*Harper's Magazine.*

"The author is himself an eminent ophthalmic surgeon, and has contributed important original investigations to the general stock of knowledge upon the subject, so that what he has now written may be said to possess the sanction of a double authority, — that of Prof. Holmgren in addition to his own." — *London Times.*

"Any one who engages in the study will find himself anticipated in every direction by Dr. Jeffries, who has pursued it with unwearied industry, and to whom the community is deeply indebted for his labors." — *Massachusetts Railroad Commissioners' Report*, 1880.

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OUR EYES AND OUR INDUSTRIES.

By B. JOY JEFFRIES, M.D.

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OUR EYES AND OUR INDUSTRIES.

Massachusetts is largely engaged in the education and preparation of teachers, as also in the education of those who are to enter the so-called learned professions, where their daily bread is to be earned by the use of their eyes. If at any time during their career these organs fail either class, they are worse than beggars, since they have by educational refinement become habituated, and their families accustomed, to a certain amount of the amenities of life, the loss of which will be most keenly felt. Besides all these members of the educational and professional classes, are the great mass of those engaged in mercantile pursuits, whose very existence depends on their ability to use their eyes most continuously. All so far spoken of come from our universities, colleges, academies, or public schools. But from the latter come also the still more numerous class who must support themselves and their families by manual industries which tax the eyes fully as much if not more than does the pursuit of the educated professions.

While so much has been said, and so much written, in notes of warning, as to the dangers of overwork and strain of the eyes, in reference to those who are in or about to enter professional life, but little has been presented to our communities as to the equally dangerous deterioration of the eyesight of those who are to engage in our industries. Publicly I raised this note of warning in "The Boston Medical Journal," and in "The Massachusetts Teacher" in 1869, pointing out some unnecessary causes of impaired vision dependent upon defects in schools, school-books, and school-teaching. My experience since then in private practice, and, of course, more especially in work at the Massachusetts Eye and Ear Infirmary, has shown me that it was quite time that the community should be equally well instructed as to the dangers of the future in reference to the so-called mechanic class, on whose continued good vision depends the position of our State as a manufacturing centre. Defective vision from unnecessary causes during school life becomes therefore a rather important subject, touching, as it does, not only the mechanic's daily wages, but the capitalist's returns and income. All the so-called learned professions, law, medicine, theology, and the others now equally recognized as professions, are, in fact, but so many agencies whose business it is to keep in working order the merchant's brain and the mechanic's hands. But while the former may scheme and think out methods of profitably employing accumulated earnings, the latter can never support himself and surroundings, or be a producer, without the eyes to guide the hands. How restricted are the mechanical occupations of the blind, even when their sense of touch is best cultivated by patient teaching!

It has seemed to me, therefore, quite time that the unnecessary causes of impaired vision, as well also as the natural and unavoidable ones which specially affect the mechanic and working classes, should be equally explained and set before those who have it in their power to control them; namely, our educational and school authorities, and those who engage any and all classes of employés in mill or workshop. While the professional or educated man, as he grows up, can, and probably will, look after himself and perhaps also his children in this respect, it is very different with those upon whom our great industries are dependent for their success, and who are the muscle and sinew of our State. These require as good, or better, eyesight, by which I mean capacity for continuous labor for many years with the visual organ, as do the educated professional or mercantile class. A bookkeeper who has to write and compute in some large concern six or eight hours a day does not have to tax his eyes more than does the mechanic in certain departments of shoe manufacturing. These are unrealized and unrecognized facts which it has long been my purpose to bring before the community, and which it is the object of this article to point out and draw attention to.

Near-sightedness or myopia has been shown to be on the increase wherever civilization is calling for further education. The warning note of the steady increase of near-sightedness with school and college life, was first publicly given by Dr. Cohn of Breslau. In 1869 I urged that the same investigations should be carried out here. Since Cohn's report, in various places in Europe and finally in several cities in this country, the same sort of investigations have been carried out, and always with similar results, viz., that many children become myopic, and go on becoming still more so with their progressive work in school, college, and university. These facts are now so well known from the many reports, etc., that even the daily press has taken up the subject in notes of warning. In 1869 my suggestions and proposals were not only refused but resisted. The contrast at present is quite striking, when the school committee of a neighboring town publish in the pamphlet report the *names* of all the children with myopic or otherwise defective eyes, as well as those color-blind. The medical and even educational journals are discussing and reporting on this deterioration of our eyes. The ophthalmic surgeon is no longer smiled at as a simple enthusiast or interested party. The statistics are already ample in this country; and while they seem to prove that we are not so badly off in this respect as parts of Europe, since our conditions are not so bad, they yet show what is the tendency, and the results of past years of neglect of the hygienic conditions necessary to prevent increasing nearsightedness. It must be remembered that myopia and the tendency to it are transmitted. Now the bad conditions of the past generation are affecting the present in this respect. It seems impossible, as I look back upon it, that so little thought and attention should have been given to schools and scholars as was formerly the case. Is it any wonder that a former generation became myopic, and handed this condition to their children now growing up at school and college? This sort of thing has not all passed away, and I want to call parents' as well as educators' attention to the fact that as bad conditions are existing now. Educators, school-committees, or teachers, are *not*, however, responsible.

Defective schoolhouses from any cause produce myopia, and help increase it when naturally present or when the tendency to it exists from birth. As I have said, these facts have been finally admitted by the community, and those in authority are more amenable to suggestions concerning feasible means of controlling myopia. Parents, too, are beginning to realize that the absolutely necessary glasses for school-children cost money, even disregarding any question of loss of vision, etc. The resistance of those whose gains or pockets are touched by the adoption of better-planned schoolhouses and school furniture, as also of those who get the control of school-book printing, etc., is too great to be at present overcome. It will, however, come in time. The industrial classes have no way of being heard, and can only *vote*. When they finally learn that increasing near-sightedness is as bad for their children as for those of the wealthy, and that there are some unnecessary causes of it they themselves can, even remotely, affect, then this vote will be directed with more thought than it now is. A mechanic who has children who are to follow his trade, or get into a higher one, begins to reflect and inquire when these children cannot study at school without glasses which *must* be purchased. And, when these parents are told of the risk of the increasing difficulty, they begin to take some interest in what is to affect the children's future means of support. Common-sense, having now finally listened to and learned from those who know what myopia leads to, will readily see how it must interfere with the increasing demands on the eyes in so many of our industries, — apart, as I would repeat, from the professions so called.

The investigations of schoolhouses everywhere have shown that want of light, or light not coming rightly, are potent causes of eye troubles. There is no excuse whatever here in Massachusetts, even in our cities, for not having properly constructed schools, with all the necessary space around them. But notwithstanding all that has been shown and said, and the good models to copy from already built here and there, schoolhouses bad in every way are building and will be built. Educators who best know, and will give the time to learn, are not allowed to build schoolhouses. It is useless to try to hide this or not acknowledge the present condition of affairs. Parents must learn why their children are hurt by school-life, and vote the remedy.

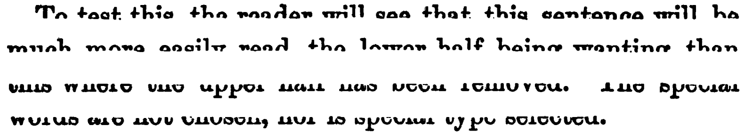
It is very necessary that school-furniture should be adapted to the size, position, and condition of the children. This is a question which has been thoroughly discussed here, as well as abroad. In my notes of warning, in 1869, I reported that Dr. Cohn of Breslau, Germany, took the bodily measurement of the more than ten thousand children whose eyes he had tested; and measured, in comparison, the school desks and seats, from which he found that all school-furniture was badly constructed, so as to readily induce or increase near-sightedness. We sent from America with considerable pride our school furniture and appurtenances to the Paris World's Fair. These were carefully examined and measured by Dr. Cohn, and, like all the others, found so arranged as to produce the evils spoken of. But contractors will continue to manufacture the forms out of which they can make the most money. These facts are no less well known than hard to combat. From various causes the tongues of those who know, and should speak, are tied. It is in no spirit of pessimism that I write thus earnestly and frankly. I have been in all the schools of my native city above the primary, and have come face to face with some twenty-nine thousand scholars, while I tested them for color-blindness. Defective school-houses and appurtenances were pointed out to me; but in many cases this was not necessary, as I had only to use the senses of sight and smell to be aware of defects of furnaces, drainage, and closets, etc. Time and again was I appealed to as a medical man to examine and give my opinion concerning such defects. I was, however, so to speak, the privileged guest of the school-committee, in my work among the scholars. Moreover I well knew that the school board had not the authority to correct mistakes of building or the errors of the past. Money has been, is, and will be, terribly wasted in the construction of schoolhouses. Persistent efforts, combined with moral courage and strict honesty, can alone, and will finally, correct these abuses.

School-books, text and reference, are bitterly complained of by all the gentlemen who have been at work testing the children's eye-sight in different parts of the world. Of course poor paper, bad impressions, worn-out type, and crowding the pages by finer and finer type, mean more money for the contractors who over-persuade committees and school boards. As these latter, however, do have it largely in their power to correct abuses, I would point out here where improvements can be made which will be of great benefit, and not too greatly touch the pockets of school-book manufacturers. For this purpose I cannot do better than here give a slight *résumé* of the extremely interesting and practical paper of Dr. Javal of Paris, on "The Physiology of Reading." It cannot fail to excite great interest, and may help to arouse the attention of those who can by persistent effort do away with some, at least, of the unnecessary causes of impaired vision. These causes are affecting the present industrial generation, and are to be handed down to the next with the increased power of heredity.

Dr. Javal's article, "The Physiology of Reading," may be found in the "Annales d'Oculistique," published in Bruxelles, 1878-79-80, and in the "Revue Scientifique," June 25, 1881. A similar article on "The Physiology of Writing," by him, nearly equally important, appeared in the "Revue Scientifique" for May 21, 1881. In these two papers he shows what can be readily done, as to writing and printing, to help relieve the strain on the eyes, which he as all others agree is one of the great causes of increasing and progressive near-sightedness in our schools and colleges. I can only here sketch the article on "The Physiology of Reading." It appeals to all readers and printers.

"We must first consider the *typical form* letters are to have, by which is meant the characteristic elements of the letter. For instance, the typical form of a V is produced by two straight lines; the terminations, the space between the two arms, etc., are not what goes to make up the typical form of a V, but two lines of equal length, meeting below at an acute angle. The accessory modifications are no necessary part, and need not exist.

"In reading, the eye has no time to examine each letter, in all its parts. In reality, the point of fixation runs along a strictly horizontal line, cutting the letters just below their tops. The other parts of the letters are seen indirectly by those portions of the retina at greater or less distance from the centre. A knowledge of this fact must influence the form to be given the letters. This fact it is proper for us to prove, since it is quite a new idea. We discovered it thus: After gazing at the print steadily we got what is called the after image, which was that of a series of faint or grayish lines, with bright interspaces. The amount of black on the letters will give only a gray line. The explanation is that the eye runs horizontally to avoid unnecessary and tedious movements, and the line is determined by the forms of the printed letters. If we cover the upper half of a line it will require considerably more effort to decipher it than if the lower half is covered; in the latter case, one can read nearly as easily as if the whole line could be seen."



To test this the reader will see that this sentence will be much more easily read the lower half being wanting than this where the upper half has been removed. The special words are not chosen, nor is special type selected.

"To return now to the cause of this, and count the letters or their parts which project above and below the body of the short letters, say in the sentence before the last, and there will be found that about five sixths project above, and only one sixth project below, the line.

"Above the line of letters we find all the capitals (all the accents in French), the dots of i and j, and the letters b-d-f-h-k-l-t, whilst below we have the letters g-j-p-q-y. Taking into account the frequency of the capitals, the dots (accents in French), and long letters, we find out of a hundred exceeding the line, eighty-five project above and fifteen below. This forces the reader to keep the eye fixed on a point above the middle of the short letters.

"This being the fact, our effort should be to give the letters forms differing as much as possible from each other at the point of fixation. Now in the last of the periods of time we spoke of, viz., from 1700 to 1840, the type-cutters seem to have striven to *avoid* this. Cover the bottom of a line of modern print so as to let only the tops of the short letters be seen, and you will find a-c-e-o-s looking nearly exactly alike, as also -n- and -r-, whilst the distinctions between -h- and -b- and -n- and p- are but slight."

This defect is less with the modern Elzevirs, in which this is printed for the reader's benefit, and it is still less marked with the types of Garamond and those of Jenson

"Before passing the alphabet in review, it is to be noticed that certain letters are naturally more readily seen than others, the long ones of course from their greater size; then the more simple ones, as -u-, are more legible than the complicated ones like -a-. We must therefore do something to render these latter more distinct.

"We would notice, also, that certain die-cutters, in order to increase the regularity of appearance, endeavor to flatten the round letters laterally, and make the square ones more round. To this we object, and much prefer to introduce some marked differences towards the tops of the short letters; for instance, a difference readily noticeable between -b- and h-. So also we would not increase the size of the bodies of b-d-p and -q, to make them of the same size as -o-, for this attempt at regularity is quite useless.

"The upper arms of d-k and -l- cause no confusion. To render -b- and h- more unlike, we should take care to make the body of -b- well rounded, and the angle which unites the horizontal and second stroke of -h- as little rounded as taste will permit: hence for uniformity's sake the body of -d must be as round as possible. It must be a little larger than -b- to appear of the same size. The letters -f- and -t- are confounded when the top of the -f- is broken, which often happens with much-used type. We should strive to prolong the bar of -f- towards the right and that of -t- towards the left, to shorten these bars on the other side, and make them as wide as possible without being too unusual. Then we should make the -t relatively short, and thicken the angle at the top and left of the letter, avoiding the hook at the bottom, which was gradually substituted for the horizontal stroke of old typography. This hook is only graceful when delicate; and, as will be seen, we are opposed to fine hair lines The form which we propose for the hook being like the old one, is an additional reason for employing it, since, all our type having rather an ancient look, the study of good taste should be regarded Among the long letters must be placed the -i-, the dot not being in contact with the body of the letter. We should make the dot thicker than the shaft of the letter. The expression *dot your i's* shows the value of the dots, and how they contribute to the visibility. It is not only important that the dot should be strong so as to avoid the confusion between -i- and -l- and -f- in small print, but also that it may not be broken off so easily. For this reason we would make the -i- a little stouter, to avoid the dot's looking disproportioned. The dot we should place as high as possible, to render it clear.

"The letters projecting downwards, g-j-p-q-y, are excellent ones. We should avoid making the -g- like the Italic -g-, because then it resembles more the -q-. Like the old Venetian print we would make the upper part more of an ellipse with axis horizontal, to increase the size, which is necessarily reduced vertically, and again use the acute angle at the top and left of the end, which was abandoned after Garamond. To -j-, we would give the old hook, by dropping off the button at the lower end: -j instead of -j-. Finally, for -y- the older form which is beginning to be seen, and is no less graceful than the newer one, where the lower part of the letter is vertical, as adopted by the French Imperial Press. The point of intersection of the two legs must be rather below the line, in order not to appear above it. For -p- and -q- we must make the body of q- rather larger than that of -p- to make them appear of the same size. Good cutters generally do this.

"As to the short straight letters, m-n and -u-, -m- ought to have a little less space between the legs; and, if the usual terminal characteristics should be used, then -u- should be a little more compressed than -n, especially at the top, in order to make it appear equal.

"We call *round* the a-c-e-o and -s-. We would conform to the custom of letting them slightly project above and below the line of the straight letters, to prevent them appearing smaller. As to -a-, we would return to the old Italian types, and of the manuscripts which served then as models, and would select an -a- whose head was very small, and did not project beyond the body. In fact, by looking at letters off at a distance, placed without order on a card, we can readily see that a-e and -s- are the worst in the alphabet. We must render -a- more simple, which may be done by reducing the size of the head, so that it will at a distance look like -r upside down (ɹ), and becomes then as legible as any other letter, if care is taken to make the body narrow and elongated. As to -c-, we would avoid the present form, which assists the confusion with -o- and -e-, and return to the older form more resembling a half-circle. For -e- we should not hesitate to go back to the old form -e-, which brings the horizontal bar nearer the line of vision in reading, and avoid having the bottom curve come up too high. Perhaps we might even make the cross-stroke inclined, as it is in some handwriting, thus increasing its length and importance. We should not fear to make the -o- quite round, though it might appear larger than -u- and -n-, and this notwithstanding the rules followed by cutters. There remains -s-, which, do what we may, is a bad letter. All we can attempt is to make it take up more room by making it more angular than usual. It would then be as legible as -z-.

"The letters having the oblique straight strokes, v-w-x and -z-, are not criticised, except that -w- and -v- must project a little below the line in order not to appear too short.

"There remains finally only -r- to be spoken of. Here we would not carry down the bar or arm, as recently done, because then it makes the -r look like -n-. We prefer the older form -r-, more original and legible."

Dr. Javal next discusses the thickness to be given the individual letters. I will not repeat it all here; but I agree with him that it is of great importance, especially with the school-books intended for children who are not myopic or presbyopic, and who are often forced to read in the class with very poor light. Dr. Javal shows what is meant by this; viz., —

[2] "This sentence is printed in the type used in the 'Revue Scientifique' in extremely delicate letters, and in that of M. Motteroz, who has employed the excellent idea of improving the modern type by reducing the length of the strokes."

[1] "This sentence is printed in the type used in the 'Revue Scientifique' in extremely delicate letters, and in that of M. Motteroz, who has employed the excellent idea of improving the modern type by reducing the length of the strokes."

"This sentence is printed in the type used in the 'Revue Scientifique' in extremely delicate letters[1], and in that of M. Motteroz[2], who has employed the excellent idea of improving the modern type by reducing the length of the strokes."

Next, the terminations of the letters are criticised. He shows, that the cutters have insensibly done what he would do, in part at least. He says, "The English use, as we French, too long terminals, but the angle between the terminal and the rest of the letter is always rounded. And to this must we not attribute the superiority of the English and American print? This is such a delicate difference that perhaps the reader has not noticed that this 'Revue' is printed in English type. It may require a magnifying-glass to distinguish the difference, but it is nevertheless the fact."

To assist the comparison this sentence is printed in French type.

"From all that has been said, it is seen that there is cause for the growing favor of English print; and this should be a reason for returning to the Elzevir type, as it is incontestably superior, as the present specimen of this sentence shows.

"In conclusion we propose a rounded form, like that designed by Jangeon, shorter than any yet adopted. Its advantage is seen in the greater legibility, especially for the fine type.

"Now as to the distances between the letters, which plays a part in the legibility.

"To be assured of this, one need but hold this page off at a distance, to perceive that this sentence, where delicate spaces are left between all the letters, is more legible than the rest of the page.

"Now, as to leading, this sentence will renew the hourly experience, and assure one that the entire suppression of leading does not diminish the legibility. The letters as they come from the fount have more space above and below than at the side. Hence it is quite clear that leading is a simple extravagance, but which need not be given up except on the ground of expense. Leading and wide margins should be kept for elaborate volumes. The library and the cheap journal will do better to use larger type than to waste the paper taken up by leading between too fine types. The editors of the French papers well understand this, and never lead their columns."

In his discussion of the important point of the size of letters, Dr. Javal says, —

"The question of the dimensions of letters has come up since the invention of printing. The written and the printed letter, at first exactly the same, have followed two quite different paths. The first books of Gutenberg were sold as manuscripts. Who would now mistake a printed for a written page?

"The cheapness of paper and the necessity of rapidity have given our handwriting its peculiar open character. At the same time, this has forced the contraction of types, since the cost of the paper is increased by the press-work. Now, how has this increase acted during the four centuries? Can the means used to economize space be bettered?

"For manuals and dictionaries which must be carried about, for the large papers and school-books, primary especially, it is useless to advise any plan which does not economize paper, for the public will not consent to any increased price, and publishers would not adopt it. We must therefore seek *to increase the legibility without diminishing the number of letters contained on a page.*

"Now, there are five ways of increasing the quantity of material on a page of given size: 1. Leaving out the leading. 2. Lessening the distances. 3. Flattening the letters so as to get more in a line. 4. Using a more delicate or thinner type. 5. Reducing the projections of the long letters.

"The first has been employed since the earliest days of printing. In fact, as one may see by looking back to page 98, leaving out the leading does not interfere with the legibility; leading simply marks expensive copies. It is absurd to use delicate type and lead it. It is much better to use type of good size, and omit the leading, although the latter gives the page rather a sombre look. To establish a limit, we should say that with the type now in use, it was better to employ No. 8 heavy than No. 7 leaded."

"For instance, this left-hand column is printed in 5 leaded, whilst the right-hand column is printed in 6 heavy, and one sees that the latter can be read farther off than the former, whilst it contains the same amount of material in less space.

"For instance, this left-hand column is printed in 5 leaded, whilst the right-hand column is printed in 6 heavy, and one sees that the latter can be read farther off than the former, whilst it contains the same amount of material in less space.

"The second means of increasing the amount of material is to lessen the distance between the letters. Referring to page 98, it will be seen that it would be better to increase the space between the letters. In reality the printers seem to have reached the limits of crowding the type.

"The third method is giving the type a narrower form, which has been employed from the commencement of printing. The popularity of the Elzevir type is due to the possibility of getting more letters in a line.

"The fourth means the printers employ to get more material into a given space consists in making the letters smaller. It is to be noticed that types do not take up less space by being simply shorter, as will be seen from this series.

14 abcdefghijklmnopqrstuvxyz
13 abcdefghijklmnopqrstuvxyz
12 abcdefghijklmnopqrstuvxyz
11 abcdefghijklmnopqrstuvxyz
10 abcdefghijklmnopqrstuvxyz
9 abcdefghijklmnopqrstuvxyz
8 abcdefghijklmnopqrstuvxyz
7 abcdefghijklmnopqrstuvyz
6 abcdefghijklmnopqrstuvxyz
5 abcdefghijklmnopqrstuvxyz
4 abcdefghijklmnopqrstuvxyz

"We see that the length of the lines lessens also with the decrease in the height of the letters, but that the reduction in breadth is much more gradual than in height, for the cutters have found that the *decrease of legibility is principally owing to the lessened breadth.* This is a fact we long ago insisted on.

"Printing on a piece of rubber which we can stretch in any direction, or looking at ordinary letters through cylindrical glasses by which we can make the type look taller or broader, will prove our assertion. Moreover, the value of broad type may be seen by holding a small type as far off as we can read it, and then, turning the page at an angle of 45° on its vertical axis, we shall find that we cannot read it, whilst turning it at 45°

degrees on the horizontal axis does not prevent our reading it easily. The value of the breadth of the letter is thus at once seen."

Dr. Javal shows how the question of wages and the delicacy of the female hand in type-setting have really modified the characteristics of the types. He says, "As to the smallest size which we would admit, it would be 8, for children learning to read."

"Another means of reducing the space occupied by printed letters is shortening the long letters." "In the papers printed with modern type, the long letters are so reduced that the space between the lines is really less than the space a short letter occupies on the line. It would seem, therefore, that we have reached the limit of reduction of the long letters. This is, however, by no means the case, as we may entirely leave out the lower projections of the long letters without much affecting their legibility. In fact, two years ago the Paris Omnibus Company, in order to save spaces of value, put their signs on a narrow band at the feet of the passengers riding on top. Necessity was the mother of invention, and the company devised the idea of substituting capitals for the letters projecting below, as has been done in this following sentence.

"It will be seen that the leGibilitY suffers much less than one would suPPose, since, as we have alreadY shown, the letters with ProJections below occur seven times *less* freQuentlY than those with ProJections above.

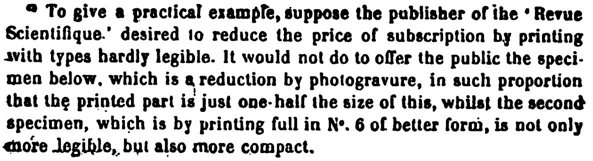
"One idea of reducing the length of the lower member rather more than the upper one seems to us to have this advantage: that, the short letters not then being in the middle of the whole height, those turned wrong side up will produce such a strong effect as to catch the attention of the proof-reader.

"We have thus proposed certain modifications of the letters, of value to increase the legibility; and we give here, in repeating the sentence, the types which come nearest to our ideas of those which are to be had in commerce."

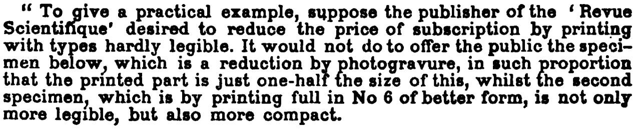
Dr. Javal then explains the value of his proposed changes in reference to smaller and smaller letters, etc. As the type grows larger these are not so much called for, and we need not depart so widely from what is established and familiar, etc.

"These and all compact types produce a disagreeable effect when they are leaded. In reality what use is there in reducing the projections when there is leading? The space can be more profitably used by giving the letters a reasonable length, particularly in books where we do not desire to save all possible room. But for school-books, primary especially, that must be cheap, and free of faults (thanks to which, generations are threatened with near-sightedness), for the daily papers so crowded and so badly printed, forming, as they do, almost the only reading of the majority of men, — for all these it seems to us that the type we have described is the most preferable.

" To give a practical example, suppose the publisher of the 'Revue Scientifique' desired to reduce the price of subscription by printing with types hardly legible. It would not do to offer the public the specimen below, which is a reduction by photogravure, in such proportion that the printed part is just one-half the size of this, whilst the second specimen, which is by printing full in N°. 6 of better form, is not only more legible, but also more compact.

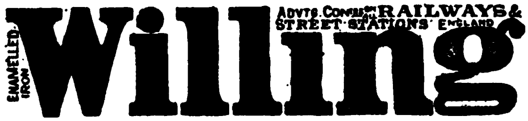


" To give a practical example, suppose the publisher of the 'Revue Scientifique.' desired to reduce the price of subscription by printing with types hardly legible. It would not do to offer the public the specimen below, which is a reduction by photogravure, in such proportion that the printed part is just one-half the size of this, whilst the second specimen, which is by printing full in N°. 6 of better form, is not only more legible, but also more compact.



" To give a practical example, suppose the publisher of the 'Revue Scientifique' desired to reduce the price of subscription by printing with types hardly legible. It would not do to offer the public the specimen below, which is a reduction by photogravure, in such proportion that the printed part is just one-half the size of this, whilst the second specimen, which is by printing full in No 6 of better form, is not only more legible, but also more compact.

" As a second example we here reproduce by photogravure a sign, a marvel of its kind, which attracts the attention of every one travelling in England.


ENAMELLED IRON
Willing
ADVTS. CONTRS. RAILWAYS & STREET STATIONS ENGLAND

" We were quite surprised to find that the agents of Willing have discovered all the artifices which we have proposed. The utilization of space is most carefully studied in these seven letters. In the type we would propose, the letters would be thinner, the bases less heavy, the -g would go a little below the line, but on the whole our type would be more or less like the above."

As to the length of the lines, Dr. Javal has shown in a very carefully prepared article in the "Annales d'Oculistique," and also in the number of the "Revue Scientifique," above given, that very extended lines on a wide page are the fruitful source of developing near-sightedness. There is a certain change of the focus of the eye necessary in following long lines, which is very annoying, and positively hurtful. Every adult will realize this in reading quartos. Let us recall how readily the children lose their place in trying to turn back from the end of the line to the commencement of the next. Perhaps our types may be set some day from right to left and from left to right in alternate lines, which would help save our eyes. Such radical change I do not even dare propose now. I would recommend Dr. Javal's most interesting and practical essays on the physiology of writing and reading to all school boards, educators, and printers. I will but quote his final sentence.

> « This postscript is printed with N°. 8 of Olive Lazare of Marseilles. In this sentence thin paper is placed between the letters. I doubt if any thing was ever printed in 8 so legible. One would suppose it was in 9. »

School Time and School Hours.

School time and school hours have been much considered; and, when so, always with the result of both being shortened. Our climate here in Massachusetts has been too little regarded, in apportioning both school time and school hours. Harvard University was forced, from the sickness and not infrequent deaths in September, to give up this month, and found that attempts at work after the middle of June were time thrown away. Now if this is true of young men from seventeen or eighteen to twenty-one or twenty-two, is it not equally true of school-children from five to seventeen? As a professional man I have had to watch many children, and I have talked with many teachers who felt free to tell me the real truth; and my firm belief is, that the whole work of exhibitions and the preparations for them, coming as they do at the end of the winter's labor and in the hottest weather, are nothing but a waste of time, brains, and money, and a very large factor in breaking down the physical condition of the scholars, which prepares them for the evil effects of the causes influencing their eyesight.

I am quite ready to meet the storm of indignation this will arouse, because I can speak from personal knowledge and experience, and because I well know who are my opponents. These latter are the teachers who are desirous of showing off their classes, which is practically throwing dust in the eyes of supervisors, school committees, etc. Then there are the whole classes of parents who thirst for their children's notoriety, and who besiege the schoolroom doors long before they are open on exhibition days. These are a nuisance and a curse to the sensible, honest teacher, so many of whom feel the absurdity of this whole exhibition business, and are thoroughly ashamed of it, but who are powerless to stem the current, and yield from very fear of loss of place or employment. Just before this exhibition work is commenced in the hot weather, *and after which no more is learned*, let the children be sent home to go to the country or seashore, or even roam the streets and haunt the public baths, and they will come back in infinitely better condition to stand the next year's work.

In our climate, children from five to seventeen can study, and study hard, under proper direction and restriction, for about nine months in the year. The other three in summer are waste of time and very great waste of physical condition, without which they cannot study at all. The extra strain and wear and tear from the preparation for examinations and exhibitions in the heat of June and July is also added to by the most absurd and hurtful custom of forcing the children to begin again the first Monday in September. No private school could exist where it was attempted, and private schools exist because this is required by the public ones. I am naturally referring to city schools and city life, and because in these all examiners have found the worst hygienic conditions affecting the eyesight. In Brussels the schools are dismissed when the glass stands at 83°. Now, the first fortnight in September is pretty sure to be the most unendurable of the summer, exhausted as we are by the previous heat. The whole of this last September (1881) was a fearful tax on scholars and teachers, but I am pleading only for the former. No schools should open before the middle of September here in Massachusetts. An earnest and faithful teacher told me that the month was thrown away even in the higher classes, and interest lost in the new studies just being entered on, which required extra exertion and more brain work. I speak with all due consideration, and as a medical man, when I say that the first fortnight of September takes away from the children a large part of the benefit they have got from the summer vacation. This applies still more to the poorer classes, who cannot escape the heat, and from whom must be ever recruited our *industrial material.*

WEARING GLASSES.

Now, as to the necessary correction of near-sightedness by properly adjusted glasses. The persistent efforts of ophthalmic surgeons are beginning to bear fruit.[1] More parents of the middle and lower classes now bring their children to our special charities in our larger cities. Of the 13,200 eye patients who applied at the Massachusetts Charitable Eye and Ear Infirmary in Boston during the past two years, 1,793 were those suffering from errors of the refraction and accommodation of the eye, and who needed to be carefully examined and tested for the glasses they required. Among these are of course very many of the present or future workers in our industries. In the smaller cities, towns, and villages, where no specialists or special hospitals exist, adults for themselves and also for their children purchase at high prices the wrong glasses of the jeweller, spectacle-dealer, or, still worse, of the peripatetic quack oculists or spectacle pedlers who overrun New England. These generally assume the name, or claim to be partners, of some of the well-known surgeons connected with special hospitals. Their cousins who do not dare try such games stand quietly at the city street-corners or railroad-stations, sure of enough fools in the course of the day to make it pay. These, like the peripatetic "professors," will soon, I think, assume the title, and be certainly believed by their customers.

Of as great if not greater importance in relation to the eyes of our industrial classes is the congenital condition called hypermetropia, or over-sightedness. Myopia, or near-sightedness, is due to the globe being *too long* or egg-shaped; and the other condition is due to the globe being too short, or too flat. It is a very common natural defect, only understood the last five and twenty years in its very practical bearings. When we look at a near object we recognize, by a sensation of effort, that the eye has to adapt itself or become focussed — *accommodate*, as it is technically called — for the distance of the near object. Now, this power of change in the eye's focus is greatest when we are some *ten years old*, and gradually decreases from then onward through life. The shorter the globe, the greater must be this accommodation; that is, the more hypermetropic, the greater the strain. When this change becomes difficult, and the strain causes pain, then the only relief is the use of carefully adjusted glasses. The community have finally recognized the need of glasses with near-sightedness, and are beginning to heed the repeated declaration of the fact that increasing myopia is most dangerous, leading not infrequently to total blindness. The natural and congenital condition of the eyeball being *too short* has not yet been appreciated or acknowledged by the laity, much less its ready relief by the use of properly adjusted convex glasses. A distinguished London ophthalmic surgeon long ago said, "Inability to use the eyes without pain and discomfort is, in the great majority of cases, due to over-sightedness; and those patients who under any other course of treatment haunt our out-patients' rooms for months and years without relief, may be speedily and permanently cured by the proper treatment of their hypermetropia, by glasses. Let us but consider the crowd of seamstresses, watchmakers, engravers, etc., who are rendered incapable of following their employment, whose future is starvation if this fact is not attended to. This is no fancy or exaggerated statement, but the every-day experience of all ophthalmic surgeons. About one-third of the cases of trouble with the refraction or accommodation of the eye are dependent on this congenital condition of the eye being too short, an optical defect only to be remedied by the use of convex glasses.

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[1] I take the liberty of referring here to my little book on "The Eye in Health and Disease," A. Moore, Boston, 1871, where will be found a simple explanation of the errors of refraction and accommodation of the eye, written for the laity and fully illustrated on hese points.

Hence no matter how *young* the person, they may need strong glasses. "What! use grandfather's glasses?" "Who ever heard of such a thing? We won't listen to it; and then to wear glasses always!" The specialist hears this till he is fairly sick of the sound, and replies, "Yes, use grandfather's glasses, or the child will break down, have to give up all study because it causes pain, and become only a hewer of wood or drawer of water, instead of a skilled artisan; or, in the upper classes, able to earn a professional livelihood, instead of becoming a drone."

As I said, there is danger of blindness from excessive or increasing near-sightedness; and this danger is becoming understood and feared in the community. But there is also danger of blindness from hypermetropia. To Professor Donders, of Utrecht, Holland, the world owes its present practical knowledge of this congenital defect. He found also that ninety per cent of crossed or squinting eyes were caused by over-sightedness. An eye which turns in away from its fellow, and hence is not used in common with it, begins to lose its power of vision, forgets how to see, and this power is not regained unless the squint is *early* corrected by an operation, and the proper glasses subsequently steadily used. Among the thirty thousand school-children I have tested for color-blindness, and hence come in close contact with, I saw hundreds of cases of squint due to over-sightedness *not corrected by operation or glasses.* These were naturally among the children of the poorer classes; as among those of the middle or upper, the opprobrium of "cock eye" leads to the parents' having the deformity remedied by operation, only too often without due recognition of the true cause of the trouble, and the necessary proper correction of the hypermetropia by glasses. But these squinting children desire to become our artisans, in which they will fail, as they practically have but one eye, and that a poor one.

The power of accommodation, that is, the effort the muscle inside the eyeball must make to focus sharply, is much more called upon in over-sighted eyes, of course in proportion to the degree of the trouble. Now, this power being greatest in early youth, and decreasing from then onwards, there may at any time come, perhaps somewhat suddenly, especially after exhausting disease or overwork, pain and utter inability to use the eyes for near work. Again, the giving out of the eyes is very apt to come, say between twenty-five and thirty-five, when among the industrial classes occupations have been chosen, and another trade cannot be learned, hence loss of eyesight is a question of starvation for themselves and families. On the other hand, properly adjusted glasses, not picked out by a spectacle vender or pedler, will entirely relieve the whole trouble, and enable persons to go on with their work as well or better than before, and their skilled labor will be thus saved for their employers, to whom it is often of course a great loss of time and money to endeavor to replace a man or woman who has learned to do certain work. I do not touch on the effect of hypermetropia in the upper or professional classes, since it is the industrial side of the question I desire to bring forward, and prove the money value of helping the employé. The physical need and commercial value of properly adapted glasses should be understood by all who are in charge of our great industries, in so many of which nowadays there is a constant call for the best eyesight.

When the over-sighted among the industrial classes apply to the ophthalmic surgeon, and are properly fitted with glasses, and the natural condition explained, etc., however well convinced of the relief afforded by glasses and the necessity of this relief, yet a constant answer is made in refusal to get them, "I can't wear glasses where I work: the 'boss' wouldn't keep me if he saw I had to use spectacles." Now, whilst this may be doubted or denied by the heads, presidents, treasurers, or superintendents of many industrial establishments, yet a more careful inquiry on their part of the custom of the *sub*-superintendents, etc., would reveal the fact that it was more or less definitely understood that a man with glasses was of no further use or not to be hired. The ophthalmic surgeons who work in our charitable special hospitals see this only too often, and have already in medical societies and elsewhere raised their voices in behalf of the employé, and in explanation of the need of his using what renders his eyes like others, and able to bear the work imposed on them, and hence able to guide his educated fingers, of such value in our industries. The wearing of glasses when needed should be encouraged, and not looked at askance, or even forbidden. The artisan classes in the large cities have already learned much on this point, because so many have now been properly fitted, not by glass dealers or pedlers, but by the patient, plodding work of the surgeons who give their time without pay to the patients crowding the waiting rooms of our special hospitals. When a man finds that glasses relieve pain in his eyes and enable him to work as he did years before, he is not likely to throw them aside or try to do without them, but will, if not allowed to wear them, if his position be endangered, or his work doubted, or his wages reduced thereby, simply leave that factory, and seek employment where it *is* recognized that the work of his hands guided by eyes rendered perfect by glasses is of value, and that there is money in *retaining* just such employés.

The human eye may be near-sighted or over-sighted in only one meridian, the horizontal or vertical, or any intermediate angle. This is not due to the globe being too long as in myopia, or too short as in hypermetropia, but to the faulty curve of the clear part of the eye in front, just as an irregular or faulty watch-glass would distort the figures and hands on the dial. This is a very frequent defect which when not corrected by properly made and selected glasses deprives the person of the use of his eyes. The unsuccessful attempts of spectacle dealers and opticians to provide proper glasses, and test their customers' eyes, is only too well known by ophthalmic surgeons to whom the poor people finally come, mulcted in time and pocket and discouraged at all attempts at relief. I never saw a case of astigmatism perfectly corrected by an optician. I have seen many provided with glasses wholly unsuited, and of no sort of value as helps to work, etc. Some spectacle dealers have already found out that honesty is the best policy, and at once advise their astigmatic customers to apply to some surgeon, or, when they cannot do this, to our charitable special hospitals. Dr. Cohn found, out of twenty-three astigmatic school-children, only one wearing cylindrical correcting glasses, and he says, "The patient, who, after long searching at the optician's, does not find any glass to suit him, is rejoiced to suddenly see every thing clear and plainly through a cylindrical glass." Another distinguished physician, himself astigmatic, says, "Cylindrical glasses have completely changed my existence; before using them I was obliged to forego all work at night, but now I read, so to speak, indefinitely by the light of a single candle."

The industrial classes are as much affected by the congenital condition known as astigmatism as are the educational or professional. Hundreds of astigmatic artisans break down from inability to use their eyes in the calling they have chosen, on account of this peculiar defect, only thoroughly understood and properly corrected these last twenty-five years. To Professor Donders of Utrecht, Holland, is the world again indebted for the practical solution of the trouble and the relief obtainable. Those directing our great industries where continued acute vision is necessary on the part of employés to make their industries *pay*, should give some heed to these arguments in behalf of their workmen, and urge rather than discountenance the testing the eyes, and wearing proper glasses.

The power of changing the focus of the eye, which is greatest at about ten years of age, changes, as I have said, and gradually decreases till at about forty-five or forty-eight, the necessary accommodation cannot be continued, and must be assisted by a convex glass. Now it is just at this time of life that an artisan is in the best physical condition to continue his skilled labor in which experience has perfected him. If the workman is near-sighted, then, although he will continue to need the same glasses for distance, he will need weaker and weaker ones for near objects, and finally be able to lay aside spectacles, except out-doors. Recall our friends whose faces we always associate with gold spectacles, and as they get on in life notice how they first push these gold frames up on the forehead at dinner, and afterwards in reading, and finally take them off, always, however, replacing them on the street, or in church, concert, etc. Only so far as all this goes, can a person be congratulated on being near-sighted: the other side of the picture I have already given.

Again, if the workman is over-sighted, with increasing years the glasses used for work must be stronger and stronger. The idea that this will go on till no glasses can be had strong enough, is simply ridiculous, as there is only a certain definite amount of change, beyond which the alteration does not go, and which is far within even moderately strong glasses.

The perfectly normal eye needs glasses at forty-five to forty-eight years of age just when the workman's experience is of value, and, just when he is likely to have a family growing up dependent on him for support, just when also he cannot turn to any other work. To deprive him of their use would be to force him out of the artisan into the lower laboring class, fairly a cruelty.

In the female sex the refusal to wear glasses, and the various pretexts and concealments so well known and recognized by the ophthalmic surgeon, are perhaps pardonable, because the admitting that they are forty-five to forty-eight years of age is confessing that they are beyond the child-bearing age, —in other words, have "grown old." Curiously enough, one rarely, if ever, hears of a woman being threatened with loss of place or employment because she has come to need glasses. On the other hand, I cannot refrain from repeating that men who require the help of spectacles and who could *work as well as ever* with them, are only too frequently afraid to wear them for fear of loss of employment. The superintendent or the "boss" ignorantly supposes that the man's eyesight has given out, while on the contrary, if he has *properly* chosen glasses, it will be better than the few years before, when he has been striving to use his eyes, which he could not focus accurately, and hence has produced imperfect or bungling work, which work has finally drawn the attention of the boss, who threatens dismissal. The poor workman seeks aid and help at some special hospital, where he finds his sight is perfect with the right glasses there ordered for him after careful testing and examination These he does not dare to wear in the shop, as the boss "don't want no man wearing spectacles." There is a most extraordinary ignorance and prejudice on this subject in the community, which it is the special purpose of this article to try and overcome. Now the workman has become skilled, steady with age and family ties, his vision will keep good till sixty-five or seventy, or beyond if he always has the proper helps to see. I ask, then, is there not money in retaining him, and should he not be kindly urged and advised to wear what his eyes require? I am too familiar with all these facts not to *know*, and hence here insist that such foolish refusal to do what nature needs is one of the unnecessary causes of impaired vision.

SPECIAL CAUSES OF IMPAIRED VISION.

I have thus far been speaking of the *natural* conditions of the eye. I would now call attention to some undoubted causes of impaired vision connected with certain industries; in other words, the special diseases or injuries produced by them. There is as great a mistake in regarding as dangerous to the eyes occupations which are not so, as in considering as quite safe others which are hurtful. I would here point out some of the industries in which money can be made or saved by attention to points either not involving any expense, or but trifling in comparison with what is saved.

A corporation treasurer told me that he once concluded to test at his mills whether all the doctors said about increased health and strength from perfect drainage had any truth in it. Accordingly, though all the drains and sanitary points connected with the mill-hands' houses would have passed muster from ordinary observers or masons, etc., he had the whole thoroughly overhauled, and each and every defect rectified. The cost was naturally considerable, some thousands of dollars, and the money seemingly thrown away, till the superintendent in charge found the absence of the skilled hands from sickness was greatly reduced, and a careful estimate proved that the whole expense of repair of drainage, etc., was thus cleared in one year. How much greater was the gain in health, strength, and happiness for the employés, benefited, perhaps, against their wills, as is so often the case!

Now, dust and dirt and foul air are the most potent causes in producing granular lids, the curse of many of the industrial classes, depriving them of months of labor if not of eyesight itself. Whilst we cannot tell the directors of our industries just how much they can save by eliminating dust, dirt, and foul air in their factories or works, we could perhaps excite their pity by showing them the effects of the same on the employés as they apply for help in our ophthalmic clinics and eye hospitals. In this article, however, no appeal is made to any feeling of humanity, but simply and directly to the pockets of stockholders, who may be induced to interest themselves, and direct superintendents and others to take cognizance of these things.

Years ago, the needle-grinders in England refused to wear the magnetic protectors over the nose and mouth, which relieved their work of any special danger, because their wages were then reduced, and they preferred the money for a merry life and a short one, though they knew it would end in lingering pain. The time has, however, about passed for this sort of thing. Most artisans nowadays are alive to the value of their physical condition as affecting their power to labor, and hence their wages.

The waste of eye-power and positive injury to the organ from lack of attention to light, position of work, and illuminating sources, are more difficult to here render comprehensible to those who have the means in their hands of correcting abuses. An expert will hardly go through any establishment without seeing the apparently total disregard of the very points which would save eyesight, and render labor so much more comfortable, safer, and hence more profitable. How often do we see an artisan at work with an uncovered flickering gas-jet close to his eyes, when an almost costless piece of tin would protect them, and give him a better light! When, in another generation or two, we shall have become accustomed to a white, instead of a yellow, artificial light, there will be saved one great cause of impure air, inadequate light and hurtful heat. This latter is often wholly overlooked in the too close proximity of all lights, student-lamps, and gas-jets, to the head as well as eyes. Let those who doubt it test, even with the hand, the temperature of the head and brow on the side towards the light and the other in comparison. The simplest additional shade stops this, by making a current of air between itself and the lamp.

A little intelligent interest on the part of superintendents and bosses would often save the company the valuable services of those who give up their handiwork from defective vision just when their educated skill is of most value. Without any reason, work-benches, tables, etc., are often placed exactly as they should not be, simply from ignorance, carelessness, or prejudice. How often do we see artisans placed facing a window, the sun glaring in so as to cause most irritating reflection from their work before them! The strain on the eyes from the constantly-repeated act of accommodating or focalizing, as the man looks back from out the window to his work, is wholly unthought of till he breaks down under it, just at the age when he is of the most value to his employer, and his wages are most needed by his increasing family. A great many good men could be retained, and a good deal of money saved, by practical inspections and suggestions in our workshops and factories, provided, of course, that those in authority would heed the specialists' reports and act on them. At present the boss's reply to all this is, "It's the man's lookout, not ours, and we can easily supply his place." Setting aside all questions of humanity, this is not true. The loss of men with trained fingers, in a special work, is of great importance. No doubt the general deterioration of many kinds of fine work is due to the present lack of continued (for years) mechanical labor. Herein lies one of the elements of the success of foreign crafts. Of course this is by no means the whole cause of the "scamping" in our mechanical industries. It is, however, an unnecessary one, which can be avoided without expense, and with gain to employers, whose attention I would challenge by this paper.

Special call for special work is sometimes a cause of positive danger, as is shown by the case I will now describe. It will, of course, meet with indignant and interested denial, by those whose pockets are touched. I, therefore, have examined the matter most carefully and most practically, taking no hearsay evidence, and convincing myself by personal examination. Those who will do as I have will, I believe, agree with me.

I have, for some time, noticed certain of the wood-cuts in the journals and magazines becoming, as I thought, poorer, blurred, and slurred, and which I could only explain by an attempt at art too high for me. My diagnosis was, that such work must be cheaper, and hence some one was making money by it, as it was not equal to the wood-cuts of former days. Wood-engravers coming to me as patients induced me to investigate the subject; and I found what has since, and recently, caused a good deal of talk in artistic and artisan circles, namely, that these wood-cuts were made from photographs on the block, thereby saving the otherwise necessary drawing on the wood. I remembered once wanting a wood-engraver to *give the idea* from a drawing hung up before him, besides what was merely photographed on the block. He greatly objected to having to look away from his work and back again at it. He would rather try to do what I suggested *as he worked* on the block, and I stood at his side. From the many and various recent articles in the daily press, magazines, etc., it is very evident that such wood-cutting is cheaper, but, as I have ascertained, it is most destructive to the eyes. The reason for this is, that the eye must constantly change its focus from the middle distance of accommodation when the picture is placed before the artist. The eye must let go or release this accommodation if it uses none in looking through the engraver's magnifying glass, or increase the accommodative effort if it employs the maximum of accommodation when using the glass. Now, young eyes, before twenty-five years, may stand this, but will be early used up by it. Many as young as thirty are affected by this cutting from photographs on wood. Of course with the photograph the lines are much more indefinite, and much more is left to the individual skill and fancy of the artist. This sort of extra work his eyes can stand, though it calls for much greater mental labor. His eyes cannot stand or hold out under the strain of accommodation necessarily connected with the looking off to the picture in front of him, from which the photograph has been taken on to the block. I have personally tested this, and do not wonder at so many engravers refusing to cut from photographs. It will not pay them in the long run, and engraving-offices will soon find that the damage to the eyes is such that men will want as much pay as would cover the cost of drawing on the block. As an ophthalmic surgeon, I have heard the complaints of engravers as to photographs. Young men who can do this work now for a few years, and who get present work in consequence, are naturally loath to say much about it for fear of losing place or work. The facts are, that photographs on wood can be cut badly by green hands, who receive but little pay, and then be "fixed up" afterwards by more experienced men. The publishers are not saved money, but the proprietors of the engraving-offices are. The latter are all, of course, in favor of photographs on wood. With them the using-up the eyes of their young men is of no consequence, as plenty of others are ready to step into their places. I have seen an engraver completely broken down by this cutting photographs, which is particularly irritating. He now refuses all such work, and has no trouble in cutting from drawings. In reality the photograph gives too much. What to leave out is difficult to decide, and hence there is much more brain work necessary. I am authoritatively informed that the better class of engravers have raised their prices, in some cases nearly double.

The wear and tear on the eyes from the constant change of focus and accommodation, has been described to me by engravers, who, of course, did not know the cause of the trouble. They complained also of the loss of time before they could see distinctly as they turned from the picture to the block, and that the first few lines then made were apt not to be good. All wood-cuts from photographs have to be worked over with loss of time and at expense of exactness.

I do not speak without knowledge, and have the evidence of at least ten first-class engravers in this country.

I expect to excite the ire of those who are pecuniarily interested in photograph work. I have, however, no other interest than that of any physician in the patients who apply to him. Engravers are satisfied with my explanation of their not being able to endure this photograph work. I have confined myself to the strictly professional point of view, and not intruded any artistic ideas of others or of my own. On these points critics have recently expressed themselves strongly in the public prints.

I have dwelt on this subject of engraving from photographs, as well illustrating how certain forms of work are hurtful, and how the harm may be done from ignorance, and also not corrected or stopped from short-sighted mercenary motives, though it would pay better in the long-run to heed the warnings given. The artisan class have but little means of combining and resisting; thus those who have learned to be of value are thrown aside, from the ruling desire to get the golden eggs by cutting open the goose.

NOTE. — In the "Revue Scientifique" for June 25, 1881, in which Dr. Javal's article is published, at p. 817, is the following: —

"*Near-sightedness in the Schools.* — On account of myopia becoming more and more frequent in the schools, from defective desks and seats, and bad lighting, etc., the minister of public instruction has appointed a commission on the hygiene of the sight in schools, with directions to examine the material conditions affecting the increase of myopia, and to endeavor to suggest means of avoiding them. This commission is comprised of Drs. Gavaret, president, Panas, Gariel, Maurice Perrin, Javal; Mortmahon, inspector-general of primary instruction; Hachette and Masson, publishers; and Gauthier-Villars, printer."

THE COLOR-SENSE AND ITS DEFECTS.

The sense of color which the eye possesses, in addition to the sense of form, has almost been forgotten as a distinct sense, so intimately does it seem associated with an impression of form. Upon it, however, depend many of our industries, as much as upon the sense of form. Its careful cultivation is very necessary for the future success of several of our Massachusetts industrial employments. At the present an educated sense of color is of great value to its possessors, and to those who require their skilled labor. Whilst women can and do enter the industries formerly occupied solely by men, the latter, from a lack of an educated sense of color, are prevented from entering the others now occupied by the female sex, simply because they lack this specially cultivated color-sense derived from natural education. All this entirely aside from the fact, which I as well as others have so thoroughly shown by the testing of thousands of males, that the latter are so destitute of and unfamiliar with color names. Color-names can and should be taught our boys in school, by which their color sense would be educated to fit them for the positions and occupations they are to support themselves by; I mean the several handicrafts. The ridiculous and false teaching as to colors now so prevalent in schools must be given up, and the color sense be appealed to and gradually educated, as is the form sense, by methods in conformity with the facts of science. On this I have dwelt, in my report to the Boston School Board on the examination of twenty-eight thousand school-children for color-blindness.[1] There is no system in the primary schools, no methods of any value, notwithstanding the praiseworthy efforts of individual teachers which I have met with. But among these latter I have found the very best deceived. A color-blind boy wholly escaped the observation of an experienced teacher who had paid special attention to the education as to colors; working, however, only with the worse than useless materials placed in her hands, or at her disposal. She was naturally indignant with me for my suggestion, and hardly credited the direct proof of the boy's color-blindness as I tested him before her, though this proof was perfectly convincing to all the other bystanders. This teacher failed simply because the means of instruction were so poor, and through no fault of her own. She followed the prescribed course. Such methods of teaching color-names and educating the color-sense as are now being largely employed in Europe, and which I am endeavoring to introduce into this country, would not only save the time of scholars and teachers, but the former could hardly escape detection if their color sense was defective or they were color-blind.[1] This would be of great value to them, as, since the color sense cannot be altered by education or familiarity with colors, or any known means, it is all-important that a boy should be warned, and his parents told, that he cannot enter the professions, trades, or pursuits where a normal color sense is necessary, and where perhaps he may be excluded by law: for instance, as locomotive engineer, or pilot, etc.; besides these, however, those many industries where the color sense is absolutely required, and many positions, as in the dry-goods business, where color-blindness will sooner or later lead to dismissal. It will not as heretofore be overlooked or concealed, since a knowledge of it is becoming so widely spread, and even the characteristic mistakes somewhat understood.

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[1] I would also refer to an article of mine in "Education," March-April number, 1882, entitled "Color-names, Color-blindness, and the Education of the Color-sense in our Schools."

The community cannot be too often reminded not to confound the lack of knowledge or use of color-names, as also the lack of proper appreciation of colors due to an uneducated color sense, and the congenital or acquired *loss* of the color sense in whole or part. The latter has been heretofore, and will be frequently, concealed. It has often led to much mortification, disappointment, and loss of time and money, as well as to grave and *fatal* mistakes. These latter I have elsewhere insisted on.[2] Here I would simply show to the owners and directors of our great industries the money value, first to them, then to their children, of systematic education of the color sense by simple and thorough methods in our schools, especially the teaching the color-names and the educating the color-sense of those scholars who are likely to learn but little through home life and surroundings, because from this class particularly are to come the future artisans upon whom will depend many of our Massachusetts industries.

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[1] Color-chart for the Primary Teaching of Colors and Education of the Color-sense. By Dr. Hugo Magnus and Dr. B. Joy Jeffries. L. Prang & Co., Boston, 1882.

[2] Color-blindness: its Dangers and Detection. Houghton, Mifflin, & Co., Boston: revised edition, 1882.

This article was written at the request of the State Board of Health of Massachusetts, and handed in in November, 1881. It will be seen that on page 7 I say, "School-books, text and reference, are bitterly complained of by all the gentlemen who have been at work testing the children's eyesight in different parts of the world. Of course poor paper, bad impressions, worn-out type, and crowding the pages by finer and finer type, mean more money for the contractors who over-persuade committees and school boards. As these latter, however, do have it largely in their power to correct abuses, I would point out here where improvements can be made which will be of great benefit, and not too greatly touch the pockets of school-book manufacturers."

Supervision of the printing of my article at Messrs. Rand, Avery, & Co.'s brought me in contact with Mr. Henry H. Clark, formerly connected with the University Press. We were mutually surprised to find an agreement in our ideas and aims. Without knowledge of the work that had been done and the suggestions made by specialists, he had practically arrived at some of the same conclusions. That my criticisms above quoted were correct, is proved by the fact that the evil had gone so far as to even begin to correct itself. I found that Messrs. Ivison, Blakeman, Taylor, & Co., of New York, had shrewdly given Mr. Clark *carte blanche* to produce the most perfect school-books as to their typography. For this purpose the latter has had special type manufactured, and unconsciously followed very much the suggestions made by my friend Dr. Javal given in my text.

In the Swinton Readers and Geographies that have been prepared, I think that any one who understands the subject will be most agreeably surprised to find what pains have been taken to save the children's eyesight by improved typography and paper. Educators and students have justly complained of the very trying and disagreeable reflection from the gloss of the paper used in text and reference books. It was claimed that in printing cuts a fine calendered surface was necessary, and there seemed to be no remedy where books were so profusely illustrated as these Readers. But it was one of the purposes of Mr. Clark to introduce not only a better type but a better paper; and he fortunately succeeded in obtaining from Messrs. Tileston & Hollingsworth of Boston, who entered heartily into his enthusiasm for good book-making, a paper without the objectionable gloss, and having all the qualities required for fine printing.

I desire to here show that I am as ready to praise, where I can do so honestly, as to blame. This page is printed in the several sized types used in the books I speak of. The idea was, to present to the child's eye sufficiently large and clearly distinctive letters; then, as he grows older, smaller and smaller letters, but of exactly the same *shape*. Thus his eye is not confused, and he has nothing new to learn. A progressive series of such type did not exist, and the matrices for the most important type were specially cut to meet the want.

COLOR CHART

FOR THE

PRIMARY EDUCATION OF THE COLOR-SENSE.

By Dr. HUGO MAGNUS,

Docent in Ophthalmology, in the University at Breslau,

—AND—

B. JOY JEFFRIES, A. M., M. D. (Harvard).

ADOPTED BY THE BOSTON SCHOOL BOARD.

The need of proper means for teaching the elements of color in public schools has long been felt, and various attempts have been made to supply apparatus suitable for the purpose. The Color Chart designed by Dr. Hugo Magnus of Breslau, and adapted for use in American schools by Dr. B. Joy Jeffries, is believed to meet all necessary requirements.

The chart contains the following standard colors: Brown, Crimson, Red, Orange, Yellow, Green, Blue, Violet, Gray, with four shades to each color in addition. Two cards for each color are furnished for the use of pupils.

The chart is accompanied by a manual for teachers, in which its practical use in the school-room is fully explained.

COMMENDATIONS.

This chart has received the highest commendation from distinguished scientists, educators, etc., from among which the following are taken: —

From Dr. A. Von Reuss, in the Vienna Medical Press.

In urging the introduction of color-teaching in the primary schools, I am but asking what has long ago been done for the ear. Music is taught in all the schools, and I will not ask whether this is not secondary to the education of the color-sense. Moreover, for this there is no call for a new subject and study among both teacher and scholar. Color-teaching must *commence* as early as possible in the kindergarten, but more definite teaching will begin in the primary school as a part of object-teaching, and afterward associated with natural-history studies. It must of course be continued in the grammar school, and only ended with professional studies.

The suggestion of the whole subject comes from Dr. Hugo Magnus, docent of ophthalmology at Breslau, who is unwearied in urging it. He here develops, as in his former writings, a definite plan for teaching colors in the primary schools, and thus offers the necessary means of instruction. I think that this method of instruction can but commend itself to all.

From Dr. S. Kalischer, in the Gegenwart, Berlin.

Of the many methods which have lately been added to school appliances for educating the color-sense, it seems to us that of Dr. Magnus, the so well-known ophthalmic surgeon of Breslau, is by far the best. Not only has Magnus's method the advantage in the variety of the colors and their shades, but also, as it seems to us, in the fact that the children are less likely to become tired, because the activity of the hands is called into play and their attention and interest excited by the necessity of searching for two special ones among the cards. This methodical system of education cannot but help, more than anything else, the distinguishing of colors, and assist in remembering them.

Dr. Jeffries says, in his Preface to the American edition: A thorough study and trial of it induced me to abandon all other ideas, and endeavor to introduce it into our schools. After I had made this decision, I was much gratified to find that the plan had met with the especial approval of the highest authority, Dr. Magnus having received the following diploma from the International Medical Congress at the Amsterdam meeting in 1879: —

CONGRÈS INTERNATIONAL DES SCIENCES MÉDICALES.

6e Session.

Amsterdam, 1879.

Diplôme d'admission avec mention honorable (distinction unique décernée par le Comité) délivré à M. le Docteur Hugo Magnus, à Breslau.

Le President, DONDERS.

Le Secrétaire Général,
Dr. GUYE; Dr. W. C. GORI.

La Direction de l'Exposition,
TILANUS, VAN LISSA.

It is with Dr. Magnus's especial consent and approval that the chart is published here in America.

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